

REMARKS

In response to the Final Action, no claims have been amended, cancelled or newly added. Therefore, claims 1-24 remain pending. In view of the following comments, allowance of all the claims pending in the application is respectfully requested.

Response to Remarks in the Final Action

In response to Applicant's arguments that the processor of Ukaji would be rendered inoperable because it calculates the displacement Δd_1 , Δd_2 and Δz from the parallelism of laser beams La, Lb and Ld, the Examiner alleges that any modification of Ukaji with Peggs must calculate Δz differently and that these calculations are basic trigonometry and are well within the scope of the skilled artisan. The Examiner further alleges that the number of parts in the system of Ukaji would be reduced, specifically indicating that the mirror 35 of Ukaji can be eliminated by providing the interferometer beam Ld normal to the mirror surface. Final Action, page 3. The Applicant respectfully traverses both of these rejections.

First, the Examiner is reminded that the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. Moreover, a statement that modifications of the prior art to meet the claimed invention would have been "well within the ordinary skill of the art at the time the claimed invention was made" because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. See, MPEP §2143.01.

The Examiner's rationale for the combination of Ukaji and Peggs relies upon the premise that the number of parts can be reduced (e.g, mirror 35 can be eliminated). Moreover, the Examiner states, in support of the assertion that the calculation of Δz must be done differently,

With the beam Ld normal to the mirror 31b of Ukaji modified by Peggs et al, then ΔLd would be the vector sum of Δx and ΔZ . Both ΔLd and Δx are measured values from interferometers 16 and 15 and the angle with respect to the Z-axis is known. These calculations are basic trigonometry and are well within the scope of the skilled artisan.

Final Action, page 3. The Applicant respectfully, disagrees.

First, the semiconductor exposure apparatus of Ukaji, as shown generally in Figure 6, includes a barrel supporting member 4 configured to support a projection lens 3 and two laser interferometers 15 and 16. The interferometer 15 is configured to measure the relative position between the barrel supporting member 4 and the substrate stage, on which are mounted a wafer chuck 20 and a moveable mirror 9. Additionally, the interferometer 15 is configured to measure the posture of the substrate stage. The interferometer 16 is configured to measure the distance between a stationary mirror 35 and the moveable mirror 9, which is mounted to the substrate stage. Moreover, the interferometer 16 is configured to measure the distance between the stationary mirror 35 and the barrel supporting member 4, which is used to calculate the position of the substrate stage in the z-direction. *See*, column 8, lines 39-44, column 9, lines 1-9 and Figure 6 of Ukaji.

Moreover, Ukaji describes the configuration of the interferometers 15 and 16 in more detail in reference to Figure 2. In this detailed description, Ukaji describes three separate interferometers 33a, 33b and 33c configured to perform measurements of a top stage 21 that supports the wafer chuck 20 with respect to the x-direction. Another interferometer 33d (interferometer 16 in Figure 6) is arranged with the interferometers 33a and 33b to be disposed along the z-direction to detect mutually parallel laser beams La, Lb and Ld. Two other interferometers 34a and 34b are configured to perform measurements of the top stage 21 with respect to the y-direction. All of these interferometers 33a, 33b, 33c, 33d, 34a and 34b are fixedly held by a same supporting member, which defines a measurement reference. Stationary mirror 35, which functions to reflect the laser beam having been reflected by inclined reflecting surface 31b coupled to the top stage to bear a z-direction component, is fixedly mounted to a supporting member that provides a measurement reference. *See*, column 5, line 43 – column 6, line 12 and Figure 2 of Ukaji.

The Examiner's alleged modification of Ukaji by repositioning the interferometer 16 (or interferometer 33d as illustrated in Figure 2) such that the laser beam would be orthogonally incident on the inclined reflecting surface of the moveable mirror 9 and the resulting recalculating of Δz would be more than basic trigonometry as stated by the Examiner. As discussed above, the interferometers 33a, 33b, 33c, 33d, 34a and 34b are fixedly held by a same supporting member. By removing the interferometer 33d from the supporting member and affixing it to another supporting member to direct the emitted laser beam orthogonal to the reflecting surface of the moveable mirror 9, it would necessitate

knowing precisely the orientation of the supporting member which supports interferometers 33a, 33b, 33c, 34a and 34b with respect to the supporting member which supports interferometer 33d. This is because the calculation of Δz requires measurement from both interferometer 33a and 33d. Moreover, it would also necessitate knowing precisely the orientation of the supporting member which supports stationary mirror 35 and the supporting member which supports interferometer 33d since the laser beam from the interferometer 33d is reflected off of the stationary mirror 35. Neither Ukaji nor the Examiner has provided anything that would lead a skilled artisan to make such a modification at least because these unknown orientations are not disclosed, and there is no discussion of how or why they should be obtained, in view of either the cited portions of Ukaji or Peggs.

In addition, as will be appreciated by one skilled in the art, the upper angled portion and the vertical portion of the barrel supporting member will be subject to different forces. For example, temperature changes, vibrations, and the weight of the projection system 3 will influence the upper angled portion and the vertical portion of the barrel supporting member 4 differently. (*See*, Peggs, column 3, second paragraph.) With this said, the cited portions of Ukaji provide no teaching as to how the upper angled portion of the barrel 4 behaves relative to the vertical portion. Therefore, positioning the interferometer 16 in the upper angled portion of the barrel 4 in the manner the Examiner has proposed without knowing the exact relationship at all times between the upper angled portion and the vertical portion will provide inaccurate results. In view of the fact that interferometers are configured to provide accurate measurements in the nanometer range, one skilled in the art would definitely not modify the cited portions of Ukaji in the manner the Examiner has proposed.

Furthermore, the determination of the parameters Δd_1 and Δd_2 , and thus Δd and ΔZ , by the interferometers 15 and 16 are based upon a particular arrangement and the resulting geometric configuration of the top stage 21, the mirror 31 have reflective surface 31b, and the stationary mirror 35 having reflective surface 35a. The removal of any component of this arrangement, such as the mirror 35, would destroy this particular geometric configuration. In other words, the Examiner's rationale for the proposed combination of Ukaji and Peggs (the elimination of mirror 35), would destroy the manner in which Ukaji calculates the position ΔZ . Moreover, the Examiner's assertion that the reconfiguration of the calculation circuit of the control unit 30 is within knowledge of the skilled artisan clearly cannot stand in lieu of the requirements of MPEP §2143.01, as discussed above.

Further, the Examiner's allegation that the number of parts would be reduced is incorrect. As discussed above, by repositioning the interferometer 33d, at least one new element would need to be introduced into the apparatus of Ukaji. This interferometer 33d would need to be mounted on another supporting member apart from the supporting member that supports interferometers 33a, 33b, 33c, 34a and 34b. The precise arrangement of this new supporting member with regard to the other elements of Ukaji's apparatus would need to be determined in order for Ukaji's to work as alleged by the Examiner.

Response to Rejections in the Final Action

Claims 1-6, 8-15, 21 and 23 remain rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs. Claims 16 and 17 remain rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs and in further view of U.S. Patent No. 5,801,832 to Van Den Brink ("Van Den Brink"). Claims 22 and 24 remain rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ukaji in view of Peggs and in further view of U.S. Patent No. 6,122,036 to Yamasaki *et al.* ("Yamasaki"). Applicant respectfully traverses these rejections for *at least* the reason that a *prima facie* case of obviousness has not been established.

Claim 1 is directed to a method of determining the displacement of an object in an apparatus along a z-direction and recites, *inter alia*, providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with said z-direction, the measuring laser beam being substantially retro-reflected and at least partly overlapping said reference beam to provide an interference signal, the object to be illuminated by a beam of radiation having an optical axis extending along the z-direction in claim 1.

With regard to claim 1, the Final Action makes reference to the Office Action mailed February 8, 2007 ("Office Action") that acknowledges that Ukaji fails to disclose the claimed feature of providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction. The Office Action then states that this feature is taught by Peggs and that it would have been obvious to one having ordinary skill in the art at the time of invention to modify

Ukaji by replacing the z-axis measurement interferometer 33d and mirror 35 of Ukaji with an interferometer in which the measurement beam is incident perpendicularly on the mirror 35 because it would reduce parts in the system.

As noted above, reconstructing the exposure apparatus of Ukaji in an effort to create the invention as recited in claim 1 by incorporating the interferometer of Peggs would modify the operational aspects of Ukaji to such a degree that the exposure apparatus would not function as described.

In particular, the exposure apparatus of Ukaji includes a wafer chuck 20 for carrying a wafer and a top stage 21 for carrying the wafer chuck 20. Connected to top stage 21 are mirrors having reflective surfaces 31a and 31b, where reflective surface 31b is at an angle to the plane of the top stage 21. Radiation Ld from interferometer 33d is incident obliquely onto mirror 31b which is then reflected to stationary mirror 35.

The cited portions of Peggs describe a small volume coordinate measuring machine (SCMM) configured to measure six degrees of freedom of a probe carrier using three compact displacement/angle laser interferometer and three miniature dual-axis autocollimators. The interferometers measure the displacement of a 'reflector cube' assembly, which includes three mutually orthogonal plates onto which three mirrors are mounted. The three mirrors are mounted at an angle to the z-axis of the CMM, such that light from the interferometers are incident on and reflected from the surface of the mirrors in a orthogonal direction. A CMM probe is mounted with the 'reflector cube' assembly to the CMM z-axis, such that the CMM probe contacts the surface of the artifact being measured. The measurements from the laser interferometer are used to calculate the position of the CMM probe with respect to a metrology frame, upon which the artifact being measured is placed. *See*, Figure 1 and section 2.1 of Peggs.

In order for Ukaji to be modified as suggested in the Office Action, the position of interferometer 33d would need to be moved or additional optics employed to direct the radiation from interferometer 33d at an angle normal to the surface of mirror 31b. Furthermore, the proposed modification will render the calculation circuit of the control unit 30 inoperable since, as shown in FIGS. 2 and 3, Ukaji makes use of the parallelism of laser beams La, Lb and Ld along the x axis to calculate displacement d1, d2 and Δz . Thus, making Ukaji unsatisfactory for its intended purpose. Therefore, there is not a proper basis for an obviousness rejection.

Furthermore, the Examiner has not provided the requisite analysis as to why one of ordinary skill in the art would combine the elements of Ukaji and Peggs in the manner that the Examiner has proposed. *See KSR Int'l. Co. v. Teleflex, Inc.*, No. 04-1350, slip opinion at page 14 (U.S. Apr. 30, 2007) (a determination must be made as to “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit”). Instead, the Examiner has only offered a conclusory statement that the number of parts in the system of Ukaji would be reduced. This is clearly inadequate under the Supreme Court's *KSR* decision since the Office Action cites absolutely nothing which supports such a conclusion. Quite to the contrary, it is respectfully submitted that the proposed modification will necessitate a plurality of additional optics (e.g., additional optics to redirect the beam reflected by the surface 31b toward the control unit 30) and a complete reconfiguration of the calculation unit. As such one of ordinary skill in the art would not be motivated to modify Ukaju in the manner proposed by the Examiner. In addition, a mere statement that a purported modification allows a particular capability (i.e., reduction in parts involved) is not a sufficient basis for an obviousness determination. Absent a teaching within the references themselves, or in the knowledge generally available to one of ordinary skill in the art, suggesting a desirability of directing a measurement beam in substantially a perpendicular direction onto the surface of the mirror within the particular context of Ukaji's arrangement and in the particular manner posited by the Office Action, the purported modification is legally incapable of supporting an obviousness determination. Thus, the purported motivation cited in the Office Action fails to provide a basis for modifying Ukaji and also fails to render obvious the particular modification (i.e., providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction) upon which the rejection is based.

For *at least* this reason, there is no legally proper teaching, suggestion, or motivation to modify Ukaji with the teaching of Peggs in the manner posited by the Office Action. Accordingly, the rejection is improper and should be reversed.

Claim 2 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a method of determining

the displacement of an object in an apparatus along a z-direction, the object having a surface which extends substantially in a plane perpendicular to the z-direction and which is illuminated by a beam of radiation having an optical axis extending along a z-direction as recited in claim 2. For example, the recited features including providing an interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with said z-direction, wherein the object having a surface which extends substantially in a plane perpendicular to said z-direction and which is illuminated by a beam of radiation having an optical axis extending along the z-direction are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claims 3-6 are patentable over Ukaji and Peggs, either alone or in combination, at least by virtue of their dependency from claim 2, and for the additional features recited therein.

Claim 8 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a lithographic apparatus as recited in claim 8. For example, the recited features including an interferometer system configured to determine a displacement of the object along a z-direction, the interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with the z-direction, wherein the normal to the mirror surface is substantially parallel to a direction of incidence on the measuring laser beam on the mirror surface are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claims 9-15 are patentable over Ukaji and Peggs, either alone or in combination, at least by virtue of their dependency from claim 8, and for the additional features recited therein.

Claim 21 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a device manufacturing method as recited in claim 21. For example, the recited features including determining a

displacement of the object along the z-direction by providing a measuring laser beam that is directed substantially perpendicularly incident on a measuring mirror with a fixed position relative to the object such that a reference line normal to the measuring mirror makes a non-zero acute angle with the z-direction are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

Claim 23 recites similar aspects as claim 1 and is allowable for similar reasons as discussed above with respect to claim 1, and for the additional features recited therein. Ukaji and Peggs, either alone or in combination, fails to teach or suggest a device manufacturing method as recited in claim 23. For example, the recited features including providing an interferometer system configured to determine a displacement of the object along a z-direction, the interferometer system including at least one mirror, wherein the at least one mirror includes a measuring mirror with a fixed position relative to the object and having a mirror surface in which a reference line normal to the mirror surface makes a non-zero acute angle with the z-direction, wherein the normal to the mirror surface is substantially parallel to a direction of incidence of the measuring laser beam on the mirror surface are not taught or suggested from the disclosure of Ukaji and Peggs, either alone or in combination.

With specific regard to claims 16-17, 22 and 24, the obviousness-based rejections fail to address the features incorporated into claims 16-17, 22 and 24 by virtue of their dependency from claims 8, 21 and 23, respectively. The obviousness-based rejections therefore should be withdrawn because they fail to address the complete combination of features represented by claims 16-17, 22 and 24.

To the extent the obviousness-based rejections are premised on the anticipation-based rejections of claims 8, 21 and 23, it is respectfully submitted that the obviousness-based rejections should be withdrawn for at least the same aforementioned reasons that require withdrawal of the anticipation-based rejections.

Claims 16 and 17 depend from claim 8, and therefore are construed to include the features of claim 8. Since Ukaji and Peggs, either alone or in combination, do not teach or suggest all of the features of claim 8 and the cited portions of Van Den Brink fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claims 16 and 17 are allowable by virtue of their dependence from an allowable base claim, and for the additional features they recite.

Claim 22 depends from claim 21, and therefore is construed to include the features of claim 21. Since Ukaji and Peggs, either alone or in combination, do not disclose all of the features of claim 22 and the cited portions of Yamasaki fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claim 22 is allowable by virtue of its dependence from an allowable base claim, and for the additional features it recites.

Claim 24 depends from claim 23, and therefore is construed to include the features of claim 23. Since Ukaji and Peggs, either alone or in combination, do not disclose all of the features of claim 24 and the cited portions of Yamasaki fail to cure the aforementioned deficiencies of Ukaji and Peggs, dependent claim 24 is allowable by virtue of its dependence from an allowable base claim, and for the additional features it recites.

In addition, it is respectfully submitted that there are significant structural and functional differences between the teachings of Ukaji and Peggs, on the one hand, and the teachings of Van Den Brink and Yamasaki, on the other hand. Those differences are such that it would not have been obvious to combine the teachings of Ukaji and Peggs with the divergent teachings of Van Den Brink or Yamasaki, let alone to have selectively extracted from those references the particular features cited in the Office Action and to have combined them in the manner posited by the Office Action. The cited art provides no motivation for the combination. A purported desire to provide the arrangement of Ukaji with a single laser source for interferometers 33a-33d, 34a and 34b as taught in Van Den Brink or an additional alignment mark as taught in Yamasaki, would not have motivated one skilled in the art to adopt the features selectively extracted from the secondary references by the Office Action. Such a combination would have required improper hindsight gleaned from Applicant's disclosure.

Thus, Applicant respectfully requests that the rejection of claims 1-6, 8-17 and 21-24 under 35 U.S.C. §103(a) be withdrawn and the claims be allowed.

CONCLUSION

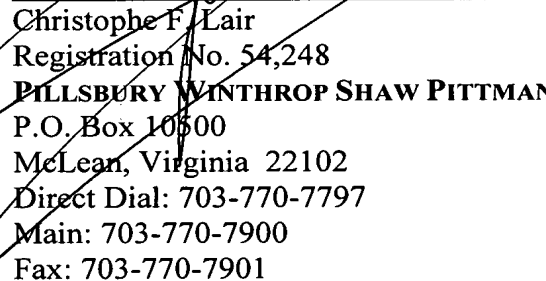
Having addressed each of the foregoing rejections, it is respectfully submitted that a full and complete response has been made to the outstanding Office Action and, as such, the application is in condition for allowance. Notice to that effect is respectfully requested.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

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Respectfully submitted,

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